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Synopsis V1.0
Single Event Transient and Latchup Testing of the
DAC8222 Analog Devices Digital to Analog Converter

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I. Introduction

This study was undertaken to determine the latchup susceptibility and single event transients (SETs) of the DAC8222 Analog Devices Digital to Analog Converter. The device was monitored for transient interruptions in the output signal and for latchup induced high power supply currents by exposing it to a number of heavy ion beams at the Brookhaven National Laboratory Single Event Effects Test Facility.

II. Devices Tested

Devices were manufactured by Analog Devices, Inc. All devices were characterized prior to exposure.

III. Test Facility

Facility: Brookhaven National Laboratory Single Event Effects Test Facility
Flux: 5.8 x 10^2 to 6.6 x 10^4 particles/cm^2/s.

Ion	Energy (MeV)	LET ($MeVcm^2/mg$)
Ni	265.9	26.6
I	343.1	59.8

IV. Test Methods

Temperature: The temperature was maintained by a cooler to less than 40 °C.
Test Hardware: Digitizing oscilloscope and programmable power supply.
Definition of a destructive event (SEL): Supply current monitored for an increase or decease.

V. Results

The Digital to Analog Converters were tested under the bias conditions of + 8 volts. Three cases were investigated to determine the sensitivity of SELs and SETs to the analog output conditions. The digital input was adjusted until the three analog output voltages of –0.6, -2.5 and –4.2 volts were obtained. For these conditions, no single event induced latchups were observed in the part to an effective LET of 85 MeV-cm^2/mg. The device, however, did experience SETs. The digitizing oscilloscope was set to trigger off of transient signals that varied from the nominal output voltage by 0.5 volts (both positive and negative transients were investigated). The cross section data and typical SETs are shown in the plots of Figure 1 and Figure 2, respectfully.

Consider first the cross section data. It appears that the saturation cross section level is independent of the output analog condition (at a value of approximately 10^{-3} cm^2). The LET threshold, on the other hand, is significantly lower for the small analog output condition. The estimated LET threshold for the –2.5 and –4.2 volt outputs is 40 MeV-cm^2/mg and for the –0.6 volt output is 10 MeV-cm^2/mg.

Next, consider the transients themselves. Figure 2 shows that the transients are oscillatory in nature with an initial negative going portion (Figure 2 shows 30 transients for the –4.2 volt output condition). The shape and nature of the transients appears to also be independent of the output voltage condition. The initial negative going pulse if approximately 1 volt in peak and slightly less than 25 ns in duration. The follow-on positive peak is approximately 0.5 volts above nominal and lasts for about 25 ns. The oscillations continue with smaller peak voltages giving and overall transient duration of 100-150 ns.

The DAC8222 Analog Devices Digital to Analog Converter is considered to have an LET threshold for latchup greater than 85 MeV-cm^2/mg. It has single event transients threshold for the –2.5 and –4.2 volt outputs of 40 MeV-cm^2/mg and for the –0.6 volt output of 10 MeV-cm^2/mg and a saturation cross section of 10^{-3} cm^2. It should be noted that for LET_{th} of 10 or less, the possibility of sensitivity to proton-induced events exists. This possibility is not addressed by this testing.

VI. Recommendations

In general, devices are categorized based on heavy ion test data into one of the four following categories:

Category 1 – Recommended for usage in all NASA/GSFC spaceflight applications.
Category 2 – Recommended for usage in NASA/GSFC spaceflight applications, but may require mitigation techniques.
Category 3 – Recommended for usage in some NASA/GSFC spaceflight applications, but requires extensive mitigation techniques or hard failure recovery mode.
Category 1 – Not recommended for usage in any NASA/GSFC spaceflight applications.

The DAC8222 Digital to Analog Converters from Analog Devices are Category 2 devices.

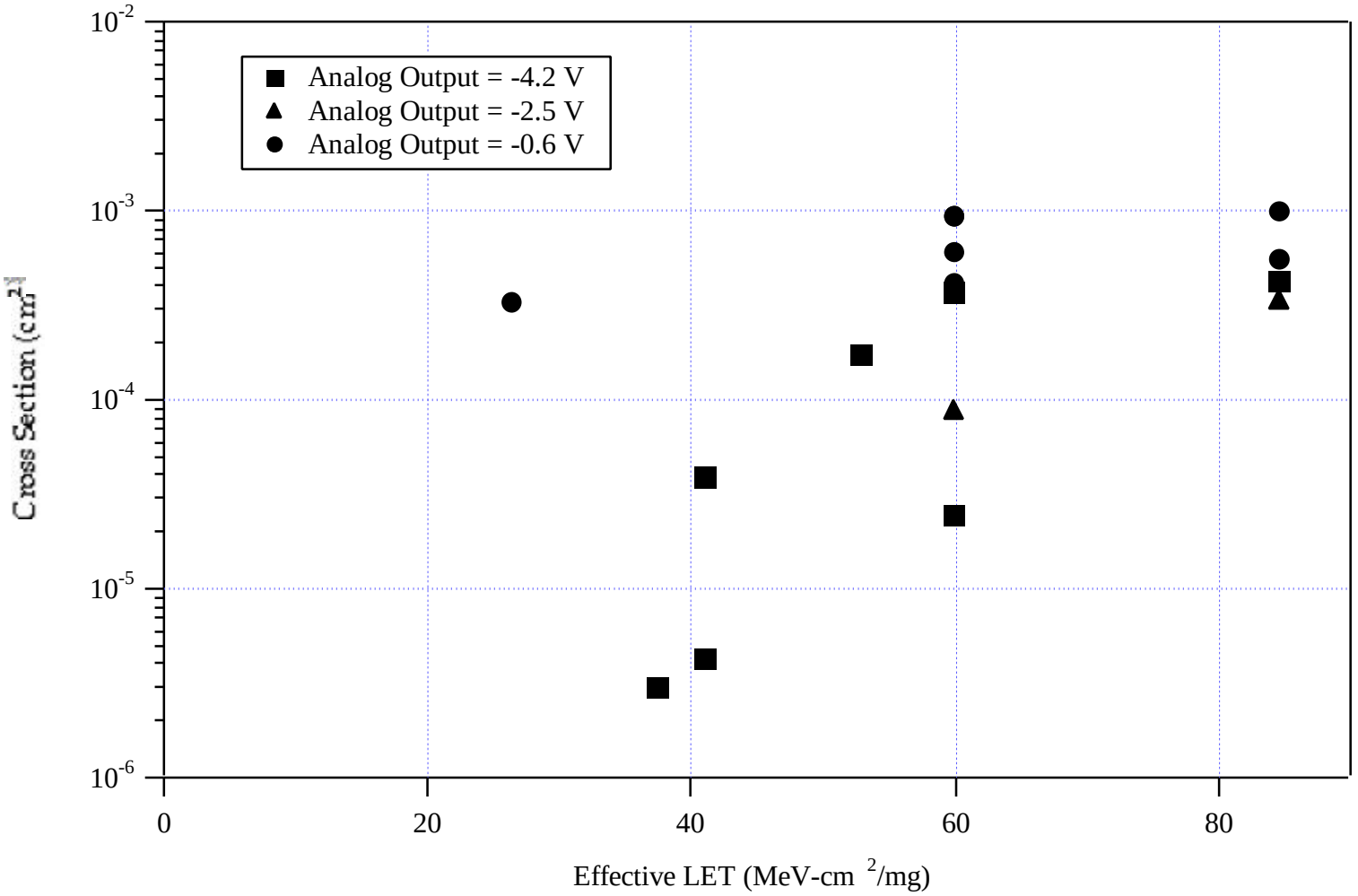

Figure 1. The symbols show the cross section data as a function of Effective LET for the three analog output conditions.

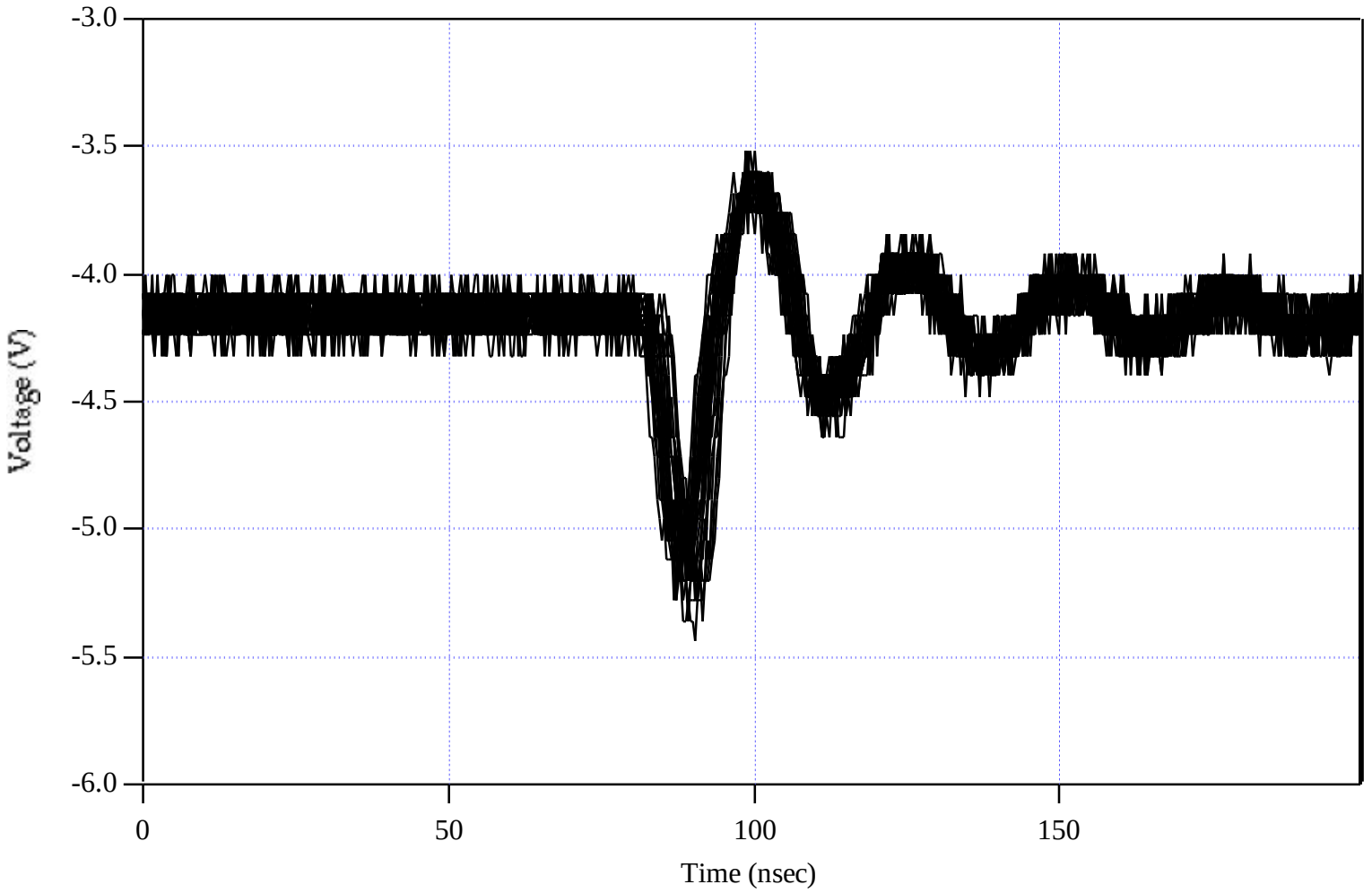

Figure 2. The curve shows representative transients, seen for all output conditions, but displayed for the –4.2 V case for simplicity.